Review of incidents at Hazardous Waste Management Facilities

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1 Introduction

The hazardous waste treatment and storage sector has a history of serious accidents and incidents occurring over recent years.

Operators of facilities regulated under the Pollution Prevention and Control (PPC) regime are required to ensure that the necessary measures are taken to prevent accidents and limit their consequences. Accident prevention is also a matter that has to be considered when determining what is the best available technique (BAT) for a PPC-regulated facility. In 2005, following consultation with the waste industry, the Agency published the Sector Guidance Note (SGN) for the Recovery and Disposal of Hazardous and Non Hazardous waste (S5.06) carried out at facilities regulated under PPC. This guidance reflects the high priority areas, including accident prevention and limitation of consequences, which were set out in the PPC Permitting plan for the waste treatment and storage sector. It sets out, amongst other things, rigorous standards for waste pre acceptance, acceptance and storage which operators should have in place. Despite this, however, further high profile incidents have continued to occur within the sector, many arising for similar reasons to previous incidents.

We review all significant incidents at waste treatment sites. The findings are disseminated to our staff in order, where possible, to prevent any reoccurrence of these incidents through our compliance work. We also review the adequacy of our guidance in light of all incidents. We have previously circulated the information that follows in an internal report. We have now decided to make our findings available to the waste treatment industry. We hope that by doing so, the knowledge gained during these investigations will enable operators to prevent similar incidents occurring at their sites.

Some of the information contained here has already been presented to members of the sector at a meeting of the PPC Waste Implementation Group. Operators have shared their experience of these incidents and the lessons their companies have learnt. We are grateful to those companies who have done so, and will continue to encourage this through the Waste PPC Compliance Group once ongoing investigations into more recent incidents are concluded.

We have summarised a number of incidents within this document covering a period of nearly 10 years. Operational practices have moved on since many of these incidents occurred, and they all pre-date the publication of the S5.06. The operations on each site, at the time of the incident, have been compared to the standards set out in S5.06, in order to assess whether S5.06 addresses the factors that were, at the time, thought to have caused these incidents We have then assessed whether there are additional measures that should be incorporated into S5.06. We have not identified any significant gaps in our guidance. The root cause of many of these incidents was incompatible or poorly characterised wastes being mixed or stored together, which is addressed in detail in S5.06.

The information on each incident has been provided by the local regulatory team for each site and reviewed by the operator. The information has been laid out as follows:

1. **The incident**
   - A brief description of the incident

2. **Description of Causes**
   - The process
   - Background Information
   - any other relevant information

3. **SGN requirements appropriate to the causes of the incident**
   - These are set out with reference to the relevant section of the S5.06 (e.g. requirements for Pre-Acceptance (2.1.1)), followed by an assessment of whether the relevant standard was met and whether any non-compliance with the standard contributed to the incident.

4. Suggested improvements to the SGN

- Identifies suggested improvements to the S5.06, that were put forward by the local regulatory team

This document will continue to be updated as investigations into more recent incidents are concluded. If there are other incidents that you believe it would be of value to include, these can be submitted by email to the PPC Waste Treatment team at the Environment Agency on the form within Appendix A1. Please send your suggestions to Jill Rooksby (Sector Co-ordinator) at jill.rooksby@environment-agency.gov.uk or Paul Fernee (Technical Advisor) at paul.fernee@environment-agency.gov.uk.

Incident 1	
Date of incident	23 April 1997
Operator Name (at time of incident)	Caird Environmental Ltd
Site Address	Minworth Treatment Facility Forge Lane Minworth Birmingham B76 1AH

1.1 Description of incident

During drum washing operations, a 45 gallon drum exploded due to a build-up of pressure inside the drum. The force of the explosion resulted in the drum flying out of the site onto the roof of a neighbouring building. The drum was one of a load of 80 nominally empty drums delivered to the site. The drums all contained residues of acetyl-chloride (a water reactive substance) and were delivered on-site to be cleaned.

1.2 Description of causes

The Process

Cleaning operations for washing water-reactive drums were undertaken outside in the site yard, in a dedicated area for this activity. The cleaning operation involved a site operative running a water lance through the lid of the drum and filling it with water. Any gases produced were then drawn off into a scrubber unit. The drums, when filled with water, were taken to the on-site treatment plant for processing.

Background Information

'Stick tests' were carried out on acceptance of the load of drums to ascertain the level of waste residues. Nominally empty drums (those with around a couple of centimetres of residue) are accepted for treatment at the site. About a quarter of the load was checked to ensure that the drums were nominally empty and suitable for washing. As each drum checked was found to contain a similar and acceptable quantity of waste residue, an assumption was made that the rest of the load was also acceptable. The drum that exploded was not nominally empty. It is likely that it contained more acetyl-chloride than the other drums in the load, but this was not picked up during waste acceptance checks. When being washed, the acetyl-chloride reacted with the washing water and released a large amount of gas, which built up in the drum quickly so that is swelled and then exploded.

1.3 Appropriate measures relevant to the causes of the incident

1.3.1 Indicative BAT requirements for acceptance procedures when waste arrives at the installation (2.1.2)

Load Inspection

Check every container to confirm quantities against accompanying paperwork. All containers should be clearly labelled and should be equipped with well-fitting lids, caps and valves secure and in place. Any damaged, corroded or unlabelled drums should be put into a quarantine area and dealt with appropriately. Following inspection, the waste should then be unloaded into a dedicated sampling/reception area.

Sampling Drummed Waste

The contents can only be identified with certainty if every container is sampled. Acceptance should involve sampling every container. However, analysis of composite samples is acceptable with such a sampling regime. A representative sample must be obtained by

taking a core sample to the base of the container. Operators should ensure that lids, bungs and valves are replaced immediately after sampling.

1.4 Suggested improvement to Sector Guidance Note

The requirement that container washing and cutting operations must take account of the former contents and any residues that may be present is not included within the “BAT box” in S5.06 but is mentioned in the accompanying text. This requirement could be made an indicative BAT standard.

1.5 Actions taken by Operator since incident

Improvements have subsequently been made by the operator, including:

- a dedicated water reactive substance drum washing area with a blast cage
- the appropriate procedure was rewritten to ensure all drums are inspected prior to processing and where excess residues are present these are treated by another process before washing out of the drum
- the process is now fully automated, and cannot start until the doors are closed and a button pressed.
- no site operative is in close proximity of the activity.

Incident 2	
Date of incident	13 January 1998
Operator Name (at time of incident)	Lanstar Limited
Site Address	Liverpool Road Cadishead Manchester

2.1 Description of incident

On 13 January 1998, the fire brigade were called in response to a fire in a skip. The fire occurred when an oxidising agent was put through a shredder in the 'small pack' facility at the site. The empty shredded containers were placed in a skip on site for disposal, where they reacted with some incompatible waste causing an uncontrolled chemical reaction. The material involved, which contained sodium dithionite, was not approved for treatment at the facility by shredding. The incident resulted in a fire and the emission to atmosphere of noxious and polluting gases.

2.2 Description of causes

Background Information

The incident arose because employees did not follow the company's internal procedures. Substances were shredded and mixed at the facility, which were not approved for treatment by the site chemist. However, the employees considered them to be safe for treatment because they were household products.

2.3 Appropriate measure relevant to the causes of the incident

2.3.1 Indicative BAT requirements for acceptance procedures when waste arrives at the installation (2.1.2)

Hazardous wastes should only be received under the supervision of a suitably qualified person (HNC qualified chemist or higher).

The Operator should ensure that waste delivered to the installation is accompanied by a written description of the waste, including:

- The physical and chemical composition
- Hazard characteristics and handling precautions
- Compatibility issues

2.4 Suggested improvement to SGN

None suggested – incident was as a result of failure to follow procedures.

Incident 3	
Date of incident	20 January 1998
Operator Name (at time of incident)	Lanstar Limited
Site Address	Liverpool Road Cadishead Manchester

3.1 Description of incident

During a routine inspection on 20 January 1998, it was discovered that fumes from a skip were affecting the premises of the business next door, with several employees complaining that the fumes were making their eyes sting and breathing difficult. Twenty people had to evacuate the area where they were working and one person was admitted to hospital.

3.2 Description of causes

The Process

A batch of waste which had been mixed in the solidification and fixation plant was discharged into a skip containing water, where it reacted exothermically producing a cloud of steam and formaldehyde gas. In order to try and control the reaction, the company mixed a further batch of waste, discharged it into the skip and doused it with water. However, the contents of the skip continued to react, and, 30 minutes after the reaction was observed, employees on the site were affected by odour.

Background Information

The incident occurred due to inadequate testing procedures. The waste received at the site was described as lime, but the site operators believed it to be calcium carbonate. The reaction that occurred when it was treated indicates it must have contained calcium oxide (which can also be described as lime), although the tests they had carried out did not reveal anything other than calcium hydroxide in the waste. The bags were marked as being a proprietary lime product and were received sealed and intact, however, no further inquiries were made of the supplier to ascertain if the contents of the 160 bags delivered could be anything other than calcium hydroxide. The wastes that reacted in the skip also included paraformaldehyde - which is solid, but at high temperatures decomposes to produce formaldehyde gas.

3.3 Appropriate measures relevant to the causes of the incident

3.3.1 Indicative BAT requirements for Pre-acceptance (2.1.1)

From the waste disposal enquiry the Operator should obtain information in writing relating to:

- Chemical analysis of the waste (individual constituents and as a minimum their percentage compositions).

Unless a sample and analysis has already been completed by a third party and the Operator has sufficient written information from them, then the Operator should in every case obtain representative sample(s) of the waste from the production process/current holder and compare it against the written description to ensure that it is consistent.

The operator should ensure that the sample is representative of the waste and has been obtained by a person who is technically competent to undertake the sampling process.

Following characterisation of the waste, a technical assessment should be made of its suitability for treatment or storage to ensure Permit conditions are met.

3.3.2 Indicative BAT requirements for acceptance procedures when waste arrives at the installation (2.1.2)

On arrival loads should:

- Have all documents checked and approved, and any discrepancies resolved before the waste is accepted.

Other than pure product chemicals and laboratory smalls, no wastes should be accepted at the installation without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.

On-site verification and compliance testing should take place to confirm:

- The identity of the waste
- The description of the waste
- Consistency with pre-acceptance information and proposed treatment method
- Compliance with permit.

This incident occurred due to management failings. Sampling of the waste did take place, and results were compared against the producers' records. However, whilst the discrepancy was acknowledged, the site operator did not check with the producer to find out why.

3.4 Suggested improvement to SGN

None suggested.

Incident 4	
Date of incident	30 May 1998
Operator Name (at time of incident)	Sarp UK Ltd
Site Address	Norwood Industrial Estate Killamarsh Derbyshire

4.1 Description of incident

The incident took place in one of the acid storage tanks holding wastes prior to neutralisation in the acid treatment plant. The storage tank (containing hydrochloric, nitric, hydrofluoric and sulphuric acid) failed catastrophically. Before the tank failed, orange and brown fumes were seen to be rising from the tank. The failure itself resulted in a wave of acid leaving the tank. It also released a dark orange ball of fumes that rose from the tank to about 30 metres in height. The fumes were kept under control by site operatives spraying the liquid with water until the fire service arrived. Police warned members of the public to stay indoors and keep windows and doors closed. Members of the public reported burning sensations in the throat, sore throats, headaches, severe vomiting, and eyes being uncomfortable to open after the cloud of fumes left the site.

4.2 Description of causes

The Process

The Killamarsh site carried out a number of different hazardous waste management processes, such as physico-chemical treatment for inorganic wastes, oil water separation, high temperature incineration, secondary liquid fuel production and solvent recovery.

Background Information

The failure of the tank was due to a rapid build up of pressure inside. This was thought to be a result of sludge in the bottom of the tank reacting exothermically with the acid mixture present, with a subsequent build up of nitrous oxides causing the orange clouds.

Samples of sludge taken after the incident showed some of the compounds within it could be “breakdown or reaction products” formed by the reaction of the acids present in the tank with coal tar based wastes. This coal tar based waste is broadly similar to creosol, which is not compatible with nitric acid.

Although the acid wastes brought onto the site the day of the incident were adequately checked and found to be suitable for storage, the presence and analysis of any sludge at the bottom of the tank was not taken into account. The company did not have any formal external inspection procedures of the acid tanks, although informal inspections were carried out.

4.3 Appropriate measures relevant to the causes of the incident

4.3.1 Indicative BAT requirements for Acceptance (2.1.2)

Once a waste has entered bulk storage or a treatment process, the tracking of individual waste will not be feasible. However, records should be maintained to ensure sufficient knowledge is available as to what wastes have entered a particular vessel / tank. For example, it is necessary to keep track of residues that will be building up within a vessel between de-sludging events in order to avoid any incompatibility with incoming wastes.

4.3.2 Indicative BAT requirements for waste storage (2.1.3)

Procedures must be in place for the regular inspection and maintenance of storage areas, including drums, vessels, pavements and bunds. Inspections should pay particular attention

to signs of damage, deterioration and leakage. Records should be kept detailing action taken. Faults must be repaired as soon as practicable.

Containers should be stored in such a manner that leaks and spillage's could not escape over bunds/edge of the sealed drainage area.

It is important to avoid accumulations of waste, which may in turn lead to deterioration in the container resulting in spillage or, in extreme cases, the deformation of the container.

Vessels supporting structures, pipes, hoses and connections should be resistant to the substances (or mix of substances) being stored. There should be a routine programmed inspection of tanks, mixing and reaction vessels including periodic thickness testing. These inspections should preferably be carried out by independent expert staff, and written records should be maintained of the inspection and any remedial action taken.

Vessels should not be used beyond the specified design life or used in a manner or for substances that they were not designed. Vessels should be inspected at regular intervals, with written records kept to prove that they remain fit for purpose. See HSE Guidance note HSG75.

Compatibility Testing

In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- Tanker discharge to bulk storage
- Tank-to-tank transfer
- Transfer from container to bilk tank
- Bulking into drums / IBCs
- Bulking of solid waste into drums or skips

4.4 Suggested improvement to SGN

HSE guidance note HSG75 specifies that methodology and record keeping is required for external and internal inspections of storage. There possibly should be a standard which specifies how often tanks should be desludged, or how potential reactions between sludges and other substances in containers should be taken into account.

Consideration should be given to including a requirement to undertake compatibility testing of tank residues with wastes to be accepted before transfer to storage or treatment.

Incident 5	
Date of incident	21 September 1999
Operator Name (at time of incident)	Caird Environmental Limited
Site Address	Minworth Treatment Facility Forge Lane Minworth Birmingham B76 1AH

5.1 Description of incident

Monitoring equipment did not detect that the stirrer within a reaction vessel had failed, leading to layering within the vessel. When the content of the reaction vessel was discharged into an IBC, with no lid, a cloud of gas smelling of chlorine was released. The IBC was not in an enclosed area and not connected to a scrubber unit.

The cloud of gas drifted to adjacent industrial units affecting a number of people who complained of sickness and difficulty breathing. The reported effects lasted from 1-2 hours to all day.

5.2 Description of causes

The Process

The activity concerned a water reaction process. The reaction vessel contained 1,000 gallons and was vented to a scrubber system. The normal method of operation is to put the water reactive wastes into the reaction vessel and add water at a controlled rate until the reaction is complete. The reaction principally produces heat and acidic water. One member of staff, the site chemist, oversees the reaction. The reaction vessel is then drained off via a flexible pipe to an IBC, which is in an enclosed area and connected to a scrubber unit.

Background Information

The subsequent investigation concluded that the reaction was likely to have come from a brominated water compound, which had not completely reacted, probably due to layering forming within the wastes in the reaction vessel. When this was discharged to the IBC, the reaction started again and gas was released.

The water reaction process has main hazards linked to heat, steam and acidic waste products. Key to controlling these hazards are the condition and maintenance of the reaction vessel, the impermeable pavements and the maintenance of the scrubber system. In this case, none of these led to the incident.

The primary cause of the incident was a failure to ensure the wastes were properly reacted. Although there were monitoring probes in the reaction vessel, on investigation these were found not to be working and there was also some doubt over whether their range of functions would have been sufficient.

A secondary cause was the decision to discharge the wastes to an IBC that was not in the enclosed area connected to the scrubber system. The operating procedure for the site, stated that the IBC should be positioned within the enclosed area which was vented via the scrubber. However it also gives the site chemist discretion to use their judgement and initiative in terms of compliance with the procedure.

5.3 Appropriate measures relevant to the causes of the incident

5.3.1 Indicative BAT Standards for Treatment - general principals (2.1.4)

General Principals

For each new reaction, proposed mixes of wastes and reagents should be assessed prior to treatment in a scale laboratory test mix of the wastes and reagents to be used. This should lead to all reactions and mixing of wastes being to a predetermined batch "recipe". It should also take into account the potential scale-up effects, for example, increased heat of reaction with increased reaction mass relative to the reactor volume, increased residence time within the reactor and modified reaction properties.

The site undertook "mimic" tests in the laboratory for other processes carried out on site, but not for the water reactive wastes. The water reaction process is not suitable for this because of the hazardous reactions, which would be dangerous in the laboratory. As a result there needs to be much more emphasis on the chemist's ability and judgement.

Where appropriate, reactor vessels (or mixing vessels where the treatment is carried out) should be charged with pre-mixed wastes and reagents. For example, reactor vessels should be "pre-limed" or charged first with the reacting alkali to control the reaction using, for example, calcium hydroxide solution made up prior to charging the reactor vessel. The decanting of sacks or drums to the vessel should be avoided. Failure to charge the vessel can lead to:

- concentration "hot spots" at the surface of the reaction liquor
- loss of reaction control
- emission of fume from the instantaneous reaction at the interface
- the open hatch venting any fume and by-passing appropriate abatement

There were hot spots and a lack of control of the process, which did not ensure thorough reaction.

The reaction should be monitored to ensure that the reaction is under control and proceeding towards the anticipated result. For this purpose, vessels used for treatment should be equipped appropriately e.g. high-level, pH and temperature monitors. These should be automatic and continuous and linked to a clear display in the control room or laboratory together with an audible alarm. Risk assessment may require process monitors to be linked to cut-off devices.

The monitoring equipment on site was not well maintained and in this case was not functioning. There was no routine maintenance schedule that checked its operation or ensured its routine servicing. The standard of the monitoring equipment fell well short of the required standard because it was very basic.

5.3.2 Indicative BAT Requirements for Management (2.3)

Operations and maintenance

Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:

- documented procedures to control operations that may have an adverse impact on the environment
- a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate
- documented procedures for monitoring emissions or impacts
- a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major 'non productive' items such as tanks, pipework, retaining walls, bunds ducts and filters

There was no procedure for identifying equipment that needed preventative or routine maintenance. There was no routine preventative maintenance programme for equipment, which could have an impact on the environment in the event of their failure.

Competence and training

Training systems, covering the following items, should be in place for all relevant staff which cover

- awareness of the regulatory implications of the Permit for the activity and their work activities;
- awareness of all potential environmental effects from operation under normal and abnormal circumstances
- awareness of the need to report deviation from the Permit
- prevention of accidental emissions and action to be taken when accidental emissions occur

Training for staff was given but follow up and refresher training was absent.

Organisation

The company should have demonstrable procedures (eg. written instructions) which incorporate environmental considerations into the following areas:

- the control of process and engineering change on the installation;
- design, construction and review of new facilities and other capital projects (including provision for their decommissioning);
- capital approval; and
- purchasing policy.

There were management procedures for the process that were largely adequate and precautionary. However the procedures were undermined inclusion of a statement that the site chemist could use their judgement on whether to comply with the procedure. This was compounded by the problem that the reaction could not be 'mimic' tested which invested even more reliance on the site chemist.

The company should conduct audits, at least annually, to check that all activities are being carried out in conformity with the above requirements. Preferably, these should be independent.

The company should operate a formal Environmental Management System. Preferably, this should be a registered or certified EMAS/ISO 14001 system (issued and audited by an accredited certification body).

The operator at that time had no formal accreditation scheme and there was no auditing of whether the site operating procedures were being followed or not.

5.4 Suggested improvement to SGN

None suggested

Incident 6	
Date of incident	October 2000
Operator Name (at time of incident)	Cleansing Service Group Ltd
Site Address	Upper Parting Tar Works Sandhurst Lane Sandhurst Gloucester

6.1 Description of incident

A fire started in the lab smalls area of the transfer station, possibly due to incompatible wastes being stored together within the same drum. The lab smalls were stored next to IBC's filled with Isopropyl Alcohol(IPA). These were close enough for a pool of burning liquid to spread under the IBC's. The taps on the IBC's expanded and IPA leaked onto the site surface. These fires under the IBC became self-fuelling due to the leaking IPA. As the fire progressed, these IBCs ruptured, causing a spread of the fire to other flammable liquids stored nearby.. When the spreading pool of burning IPA reached these containers, they are believed to have ruptured under the intense heat and exploded, producing large fireballs.

The fire spread to other areas of the site, including the designated storage area for cleaned drums and IBCs. The site office was located close to this area, and it too became involved in the fire. The fire also spread to a road tanker, which had been used on site for bulking up and storage of chlorinated solvents. The tanker seals failed in the heat, allowing the contents to escape. The contents are believed to have been incinerated within the fire, causing the formation and release of hydrogen chloride gas, phosgene and possibly some chlorinated hydrocarbon vapours.

Residents from the village close to the site were evacuated. Many complained of breathing difficulties and other symptoms associated with inhalation exposure to a variety of non-particulate toxic combustion products and respirable air particulates.

6.2 Description of causes

Background Information

On review of the lab smalls storage area, it was found that drums containing lab smalls had the following problems:

- single drums contained incompatible wastes which had mixed hazards e.g. water reactive wastes in the same drum as flammable liquids;
- some drums contained unknown wastes;
- some were poorly packaged and also included packaging which was in itself easily flammable such as cardboard.

Fire Spread

Flammable and highly flammable liquids were stored in plastic IBCs. These containers were easily breached in the fire, and released strong flows of burning liquid. There was no provision for controlling the flow of burning liquid in the event of fire – for example designated bunded areas for flammable liquids .

There were no firebreaks between storage areas. Areas that did not contain flammable waste were compromised by the storage of empty plastic drums and IBCs, which provided a pathway for fire to spread.

The IPA was initially thought to be flammable but on review was classed as highly flammable which altered its hazard. However this was not recognised in positioning the waste on site. Additionally the IPA had not been formally designated a storage area or been put in with the

other flammable wastes. The storage adjacent to the lab smalls area had been an ad-hoc arrangement that had become accepted practice on the site.

The fire service attended the incident but were hampered in their ability to deal with the fire because;

- The access road passed close to the boundary of the site and was affected by the fire itself, in particular smoke and there was no alternative access.
- No site inventory existed. The records of wastes had been stored in the site office, which burnt down, with no additional copies kept available off site. Also there were unknown wastes on site and wastes that would not have appeared on the inventory.
- The site was affected by rocketing metal drums and aerosol cans.

Flooding Incident

The River Severn flooded the site three days after the fire incident. Wastes that were subsequently identified as water reactive were inappropriately stored causing further pollution.

Investigation

The subsequent investigation raised concerns regarding the site operations. Some of these had influenced the fire and flooding incidents, while others had played no part but could have led to further environmental consequences. In particular, it was found that although appropriate procedures were in place they weren't necessarily being followed. For example, the operators had a rejection procedure, but this was not being followed as rejected wastes were not being removed from site.

When the site flooded, it became apparent that the contents of 3 drums had reacted and led to a release on site, which was noticeable as a red staining on buildings and equipment. It took 4 months to trace the details of the waste, which turned out to be selenium grinding sludge wastes, which had been kept on site as no onward disposal route had been found. The wastes had been mis-described by the waste producer and sales contact during pre-acceptance and the hazards associated with the waste were not correctly identified. These wastes were found to be water reactive.

In addition to this, 7 drums of waste were found on site, which had originated from early BSE research. The waste originated from the former Veterinary Laboratories Agency, and had been designated for disposal by incineration. This had been agreed with the original waste contractor removing the wastes. The waste contractor stopped using the designated incinerator and obtained a quote from CSG for removing the wastes. The wastes had been on site for four years and had managed to become “lost” in the site and missed off the site’s inventory of wastes.

Another issue picked up by the subsequent investigation was that the site had accumulated radioactive wastes (mostly low level small sources) from the lab smalls collections. The site chemists, when unpacking the wastes, were separating out laboratory chemicals such as uranyl nitrate, and storing them in 45 gallon drums. This practice seemed to have its roots in trying to be helpful to the customer, however the chemists had failed to flag this up to site management. The company had failed to remove the holding they had on site and stop the intake of such wastes. As a result, the accumulations were becoming a hazard.

6.3 Appropriate measures relevant to the causes of the incident

6.3.1 Indicative BAT requirements for pre-acceptance (2.1.1)

From the waste disposal enquiry the Operator should obtain information in writing relating to:

- the type of process producing the waste
- the specific process from which the waste derives
- hazards associated with the waste

There must be a clear distinction between sales and technical staff roles and responsibilities. If non-technical sales staff are involved in waste disposal enquiries, then a final technical assessment prior to approval should be made. It is this final technical checking that should be used to avoid build-up of accumulations of wastes.

It became apparent after the incident that some wastes (e.g. the selenium waste, BSE-contaminated solvents) were accepted onto site without any onward disposal option being confirmed, leading to accumulations of wastes that posed disposal problems.

For laboratory smalls, whether or not the operator of the installation packs them on behalf of the producer, a full list of laboratory smalls should be created and transported with the waste. Operators should have written procedures regarding the segregation, packaging and labelling of laboratory smalls.

Many of the laboratory smalls stored on site were improperly packed, and not clearly identified.

6.3.2 Indicative BAT requirements for acceptance procedures when waste arrives at the installation (2.1.2)

Other than pure product chemicals and laboratory smalls, no wastes should be accepted at the installation without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.

On-site verification and compliance testing should take place to confirm:

- consistency with pre-acceptance information and proposed treatment method.

Acceptance testing did not take place for all containerised wastes, with the result that wastes were subsequently stored inappropriately.

6.3.3 Indicative BAT requirements for waste storage (2.1.3)

General Storage Requirements

Storage areas are often the most visible aspects of the installation. Storage areas should be located away from watercourses and sensitive perimeters, for example, those which may be adjacent to public rights of way, housing or schools, and within the security-protected area of the installation to prevent vandalism.

All containers should be clearly labelled with the date of arrival, relevant hazard code(s), chemical identity and composition of the waste and a unique reference number or code enabling identification through stock control and cross-reference to pre-acceptance and acceptance records. All labelling should be resilient enough to stay attached and legible throughout the whole time of storage at the installation.

Storage area drainage infrastructure should ensure that all contaminated run-off is contained, that drainage from incompatible wastes cannot come into contact with each other and that fire cannot spread between storage/treatment areas via the drainage system.

Turnover

Storage within the reception area should be for a maximum of five working days. Following receipt, wastes should be treated or removed off site as soon as possible. The total storage time will depend on the characteristics of a particular site and the waste types being stored. For example, on a site in a sensitive location handling hazardous wastes, it may be appropriate to limit storage times to one month. Other non-hazardous wastes, however, may be held on site for longer periods. However, all waste should be treated or removed off site within a maximum of six months of the date of receipt.

Storage of drummed waste and other containerised wastes such as IBCs

Storage areas for containers flammable or highly flammable wastes should meet the requirements of HSG51, HSG71 and HSG176

Segregation

In addition to the requirements of this document, the segregation of the wastes should meet the requirements of HSG71 and must be justified by risk assessment.

Storage of aerosols

Storage of aerosols should take place under cover in closed containers or cages. Aerosols should not be stored in open containers.

Storage of lab smalls

Incompatible substances should not be stored within the same drum. Sorting and repackaging of laboratory smalls should take place in a dedicated area/store. Once the wastes have been sorted according to their hazard classification, with due consideration for any potential incompatibility problems, and repacked, then these drums should be not be stored within the dedicated laboratory smalls area but should be removed to the appropriate storage area.

There were examples of storage arrangements falling short of the above in a number of areas, and the spread of the fire across most of the storage area was believed to have been a direct result of these issues.

6.3.4 Indicative BAT Requirements for management (2.3)

Operations and Maintenance

Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be;

- a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment.

Competence and Training

Training systems covering the following items should be in place for all staff which cover;

- awareness of all potential environmental effects from operation under normal and abnormal circumstances.
- prevention of accidental emissions and action to be taken when accidental emissions occur.

Accidents/incidents/non-conformance

There should be an accident plan as described in Section 2.8 which;

- identifies the likelihood and consequence of accidents
- identifies actions to prevent accidents and mitigate any consequences

6.3.5 Indicative requirements for accidents and abnormal operation (2.8)

A formal structured management plan should be in place which covers the following aspects:

A – Identification of the hazards to the environment posed by the installation using a methodology akin to a Hazop study:

- arrangements for the receipt and checking of incoming wastes, including rejection and quarantine

- arrangements for storage, segregation and separation of differing waste types
- failure to contain firewater
- incompatible substances coming into contact

B - Assessment of risks. The hazards having been identified, the process of assessing the risks should address six basic questions;

- how likely is the event to occur
- what substances are released and how much of each
- where do the released substances end up
- what are the consequences
- what are the overall risks
- what can be done to reduce the risk

C - Identification of the techniques necessary to reduce the risks. The following techniques are relevant to most installations;

- there should be an up to date plan showing the precise location of wastes having specific hazard characteristics
- where the installation is in a floodplain, consideration should be given to techniques which will minimise the risk of the flooding causing a pollution incident or making one worse
- appropriate control techniques should be in place to limit the consequences of an accident, such as; fire walls, firebreaks, isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.

6.4 Suggested improvement to SGN

With regard to indicative BAT requirements for waste storage (2.1.3), points 23 and 25 relating to storage and segregation of non-compatible waste are fundamental to the incident, the BAT guidance may not be not sufficiently robust on this point.

Incident 7	
Date of incident	2001
Operator Name (at time of incident)	Park Environmental Ltd
Site Address	Park House Corporation Road Newport

7.1 Description of incident

The incident occurred when three times the normal amount of caustic was added to a treatment tank in one go. This produced a vigorous reaction and a cloud of hydrogen sulphide gas was released. The incident was only noticed when an employee (the site chemist) was found unconscious within the building where the treatment was taking place.

The alarm was raised and the site chemist attempted to shut the batching and mixing process down remotely using the automated system. When this failed to respond, the chemist decided to attempt to shut the system down manually close to the tank. He entered the building and was later found by the fire crews. He was pronounced dead on arrival at hospital.

7.2 Description of causes

The Process

The site operated almost entirely on one process, an acid/alkali neutralisation process. Most wastes were acids that were treated with caustic/lime sludges. Neutral sludges containing metals were also accepted for treatment. The acids and alkalis were mixed and neutralised, which precipitated out the metals into sludges.

The caustic / alkalis were added at a controlled rate and mixed to produce a controlled reaction. At the end of the addition the mixture was left for 6-7 hours for the reaction to complete. The sludge was then pumped from the bottom of the tank and pressed. The supernatant liquors were sent for disposal to sewer. The sludge was sent for disposal to landfill.

Background Information

Pre-acceptance testing was in place. Any waste streams proposed for the plant were checked for compatibility with the treatment within the terms of the Waste Management Licence and the Trade Effluent Agreement. Virtually all the wastes arrived by tanker. Before offloading, a sample would be taken and analysed for pH, specific gravity, visual appearance and odours. If this proved compliant with the pre-acceptance checks, the waste was offloaded and put into either:

- an empty treatment tank or
- a treatment tank holding compatible wastes or
- the site's holding tank.

After pre-acceptance testing the wastes stream was given a unique name/identifier.

There was no consideration of whether reactions may liberate gasses or toxic gasses. The site was not equipped with any gas monitoring / alarms in the building. At the waste acceptance phase, mimic tests were carried out but these did not monitor for gaseous emissions.

While the tanks were structurally sound, certain parts of the maintenance had been neglected. These included:

1. The lids of the tanks were in very poor condition although they were not designed to be sealed.
2. The pumps, which were used, for emptying the tank of sludges were located inside the tank which made them difficult to maintain and they had not been working for some period. Therefore another system using a pump suspended on a gantry had been installed. Because of this, the tank had a very large accumulation of sludges at the bottom containing various contaminants, which were largely unknown.
3. The mixing system had become compromised by the accumulations of sludge.

The Agency were concerned with the state of the tanks and were considering enforcement action, however, the actual conditions of the sites Waste Management Licence were being complied with.

The incident happened just after responsibilities were handed over to a recently recruited and inexperienced chemist. The hand-over between the chemists was during the shift change. It was very brief and the new chemist was not fully informed of what stage the reaction in the tank was at. The new chemist was under the impression that the process was nearly completed. Level gauges/alarms for the tank were absent and would have helped in this respect.

It was initially considered that the quick reaction and liberation of hydrogen sulphide gas was caused by the addition of too much caustic too quickly. However the investigation could not reproduce the amount of gas from the wastes added alone. The investigation concluded that the sludge in the bottom of the tank contained residues of poly-sulphides from the wastes that had built up over time. The reaction was aided by the fact that thermoclines were probably present in the wastes, initially keeping the acids and caustics layered and subsequently assisting a rapid reaction.

There were failings in the management systems on site, which included:

- poor handover procedures between the chemists,
- the lack of auditing/maintenance of equipment and
- the lack of health and safety procedures which allowed the chemist to re-enter the building.

The subsequent investigation also found that financial considerations were almost solely driving company affairs. The company was not rejecting new waste streams and the strengths of acids that were accepted for treatment rose steadily until very high strength acids were included in the accepted waste streams.

7.3 Appropriate measures relevant to the causes of the incident

7.3.1 Indicative BAT requirements for pre-acceptance (2.1.1)

Analysis

Further analysis may include other parameters relevant to the treatment method or waste stream e.g.

- presence of sulphide

7.3.2 Indicative BAT requirements for Acceptance (2.1.2)

Once a waste has entered bulk storage or a treatment process, the tracking of individual waste will not be feasible. However, records should be maintained to ensure sufficient knowledge is available as to what wastes have entered a particular vessel / tank. For example, it is necessary to keep track of residues that will be building up within a vessel between de-sludging events in order to avoid any incompatibility with incoming wastes.

7.3.3 Indicative BAT requirements for waste storage (2.1.3)

Compatibility Testing

In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- Tanker discharge to bulk storage
- Tank-to-tank transfer
- Transfer from container to bilk tank
- Bulking into drums / IBCs
- Bulking of solid waste into drums or skips

7.3.4 Indicative BAT requirements for treatment – general principles (2.1.4)

General Principles

Provide adequate process descriptions of the activities and the abatement and control equipment for all of the activities such that the Regulator can understand the process in sufficient detail to assess the operator's proposals and in particular to be able to assess opportunities for further improvements. This should include:

- details of chemical reactions and their kinetics/energy balance
- description of how protection is provided during abnormal operating conditions such as runaway reactions, unexpected releases, start-up, momentary stoppages and shut-down for as long as is necessary to ensure compliance with release limits in Permits

For each new reaction proposed mixes of wastes and reagents should be assessed prior to treatment in a laboratory scale test mix of the wastes and the reagents to be used. This should lead to all reactions and mixing of the wastes being to a predetermined batch "recipe". It should also take into account the potential scale-up effects, for example, increased heat of reaction with increased reaction mass relative to the reactor volume, increased residence time within the reactor and modified reaction properties. See HSG143 for further Guidance.

The reactor vessel and plant should be specifically designed, commissioned and operated to be fit for such a purpose. Such designs should include consideration of chemical process hazards and a hazard assessment of the chemical reactions, prevention and protective measures together with consideration of process management i.e. working instructions, staff training plant maintenance, checks, audits and emergency procedures.

All treatment/reaction vessels should be enclosed and should be vented to atmosphere via an appropriate scrubbing system.

The reaction should be monitored to ensure that the reaction is under control and proceeding towards the anticipated result. For this purpose, vessels used for treatment should be equipped appropriately e.g. high-level, pH and temperature monitors. These should be automatic, continuous and linked to a clear display in the control room or laboratory together with an audible alarm. Risk assessment may require process monitors to be linked to cut-off devices.

7.3.5 Indicative BAT Requirements for management (2.3)

Operations and Maintenance

Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be;

- a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major 'non productive' items such as tanks, pipework, retaining walls, bunds ducts and filters

Competence and Training

Training systems covering the following items should be in place for all staff which cover;

- awareness of all potential environmental effects from operation under normal and abnormal circumstances
- prevention of accidental emissions and action to be taken when accidental emissions occur.

Accidents/incidents/non-conformance

There should be an accident plan as described in Section 2.8 which;

- identifies the likelihood and consequence of accidents

7.4 Suggested improvement to SGN

Consideration should be given to including a requirement to undertake compatibility testing of tank residues with wastes to be accepted before transfer to storage or treatment.

Incident 8	
Date of incident	12 April 2002
Operator Name (at time of incident)	Distillex ltd
Site Address	East Percy Street North Shields North Tyneside

8.1 Description of incident

A major fire developed on the site after an IBC containing flammable substances was cut for disposal using an angle grinder. The angle grinder produced a large number of sparks that ignited the contents of the IBC. Despite attempts by site operatives to tackle the fire, it spread quickly through the site.

A contributory factor in the rapid spread of the fire was a number of plastic and steel containers containing flammable and combustible liquids stored outside of bunded areas on site. This reduced the separation distances between stacks of flammable liquids and meant there was an absence of secondary containment.

The fire led to exploding drums of flammable liquid being projected off site. It also spread to some neighbouring premises. The emergency services evacuated people within a half-mile radius of the site. The site buildings and one neighbouring building had to be demolished. The local health authority reported 5 casualties and the police reported 36 injuries on duty resulting from the incident.

The company had not produced any written procedures to provide information, instruction or training to employees on the methods to be used for the disposal of IBCs. Channels for communication of instructions to the site operative cutting the IBC's were not clearly defined.

8.2 Description of causes

The Process

IBC's were normally cut in the centre of the yard. However, in this case, cutting occurred between the site skip and the nearby crude storage area. The container being cut contained Solvent 30 - which contains isoheptanes and cycloheptanes with a flash point of 2 degrees celcius, and 4,4-Difluorobenzophenone, which is a combustible solid. Sparks from the angle grinder ignited the IBCs contents causing the fire.

8.3 Appropriate measures relevant to the causes of the incident

8.3.1 Indicative BAT requirements for management (2.3)

Operations and maintenance

Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:

- documented procedures to control operations that may have an adverse impact on the environment.

Competence and training

Training systems, covering the following items, should be in place for all relevant staff which cover

- awareness of all potential environmental effects from operation under normal and abnormal circumstances

8.3.2 Indicative BAT requirements for waste storage (2.1.3)

Storage of drummed waste and other containerised wastes such as IBCs

Storage areas for containers holding flammable or highly flammable wastes should meet the requirements of HSG 51, HSG 71 and HSG 176.

Segregation

In addition to the requirements of S5.06, the segregation of wastes should meet the requirements of HSG71 and be justified by risk assessment.

8.3.3 Indicative requirements for drum washing, crushing, shredding and cutting (2.1.13)

Processing of containers should only be undertaken in accordance with written instructions. These instructions should include which containers are to be processed and the type of container to hold residues.

8.3.4 Indicative requirements for accidents and abnormal operation (2.8)

Identification of the techniques necessary to reduce the risks.

The following techniques are relevant to most installations:

- procedures should be in place to avoid accidents occurring as a result of poor communication between staff at shift changes or during maintenance or other engineering work.
- Appropriate control techniques should be in place to limit the consequences of an accident, such as, fire walls, firebreaks, isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.

8.4 Suggested improvement to SGN

There is no statement in S5.06 that hot cutting/grinding is not an indicative BAT standard. As many alternatives are available, e.g. handsaw, bolt cutters, and the potential for fire and

explosion at hazardous waste management facilities is high, these alternatives should be made BAT standards and hot cutting/grinding deemed inappropriate.

The requirement that container washing and cutting operations must take account of the former contents and any residues that may be present is also not a BAT standard, but is mentioned in the accompanying text. It could be included as a BAT standard.

Incident 9	
Date of incident	3 March 2004
Operator Name (at time of incident)	Shanks and McEwan (Shanks waste services)
Site Address	Plot 3 Tofts Rd West Hartlepool Cleveland

9.1 Description of incident

The incident took place in the site's waste transfer and storage area when 4X160l and 4X205l drums containing Li/Cu strip off-cuts reacted with moisture present either in the packed drum or from water ingress from storage outside.

The initial fire, reported to the fire brigade at 19.01hrs, happened when a 160l drum split open due to pressure build up and a 30cm spool of waste Li/Cu spilt onto the concrete. A witness described a classic metal fire "that appeared to dance like sparklers". The fire brigade attended the incident and after discussion with the site chemists, used water to cool the area to prevent the fire spreading further as an inventory of chemical waste on the site could not be provided. The site had only dry powder extinguishers which the fire brigade considered too dangerous to use due to the metal fires random path around the yard and the possibility of endangering fire-fighters.

A water curtain was set up to cool the fire and thermal imaging equipment used to monitor the heat of the fire at its seat, the 160l drum. After cooling for an hour the fire brigade stood the incident down as temperatures where returning to normal. At 21:00 a large explosion occurred in the drum storage area and burning spools of Li/Cu was showered over the entire site causing numerous secondary fires. The local residents at Seaton Carew were warned to close all doors and windows and stay inside as smoke was being blown in the Towns direction. The smoke situation was further exasperated by the secondary fires in the tank farm and flammable waste storage area. The main "non-haz" tanks were made of glass reinforced resin which was burning rapidly and giving off acrid toxic fumes. Five firemen were treated for smoke inhalation with two being admitted to hospital for monitoring overnight.

Throughout the incident numerous flammable liquids in storage exploded, ranging from 25l to 205l drums of solvents. Due to fact that an inventory of materials on the site could not be provided the Agency advised the fire brigade of the waste streams allowed under the licence and the fire was fought with the aim of containing it and preventing it spreading to other areas. At its highest 12 fire engines and 60 firemen were fighting the blaze. By 09:00 the following day the situation was under control and all secondary fires were out, with only the water monitor continuing to cool the drummed waste bays.

9.2 Description of causes

The Process

The Hartlepool site carries out two specific hazardous waste treatment processes, namely physico-chemical treatment by filter press and oil water separation. A broad spectrum of waste types were also allowed under the site WML in relation to the waste transfer station including pre-cursors, inorganic and organic flammables etc.

The Cause

Waste lithium/copper strips from the manufacture of dry cell batteries were accepted onto the site contrary to the site licence which specifically excludes both alkaline earth metals and water reactives. The Li/Cu strip is used as the anode in dry cell batteries of the type found in modern watches. The material is a two sided strip, about the same width as a 35mm camera film, and is wound onto metal spools similar in appearance to cine films reels and about 30cm in diameter. As virgin product it is hermetically sealed in a dry room within foil packets and further sealed within 160l UN approved containers and shipped from the manufactures as a UN packing group II product. The material that caught fire was no longer sealed. It was wound back around the spool in some cases, and simply scrunched up in others, before being placed in waste 205l and 160l drums. The material had, according to the paperwork, been packed by a Shanks chemist and the waste producer paid for this service.

Background Information

The failure to correctly store and package the material led to a reaction, most likely with moisture present within the waste drums. This in turn lead to a metal fire and the resulting explosions.

A very serious situation was worsened by the lack of a site inventory. This lead to the fire brigade having to fight the fire defensively rather than being able to attack points selectively to prevent is spread. In effect the fire brigade had to drench the site and let the fire burn itself out.

Time of the incident

Had this incident occurred in summer not winter and the wind direction not changed, injuries from the fire's smoke could have been more numerous and serious.

9.3 Appropriate measures relevant to the causes of the incident

9.3.1 Indicative BAT requirements for Waste Acceptance procedures (2.1.2)

The operator should have clear and unambiguous criteria for the rejection of wastes, together with a written procedure for tracking and reporting such non-conformance. This should include notification to the customer/waste producer and the Environment Agency. Written/computerised records should form part of the waste tracking system information. The operator should also have a clear and unambiguous policy for the subsequent storage and disposal of such rejected wastes. This policy should achieve the following:

- Identifies the hazards posed by the rejected wastes
- Labels rejected wastes with all information necessary to allow proper storage and segregation arrangements to be put in place
- Segregates and stores rejected wastes safely pending removal

The Waste Management Licence specifically excluded both alkaline earth metals and water reactives.

9.3.2 Indicative BAT requirements for waste storage (2.1.3)

Procedures must be in place for the regular inspection and maintenance of storage areas, including drums, vessels, pavements and bunds. Inspections should pay particular attention to signs of damage, deterioration and leakage. Records should be kept detailing action taken. Faults must be repaired as soon as practicable.

It is important to avoid accumulations of waste, which may in turn lead to deterioration in the container resulting in spillage or, in extreme cases, the deformation of the container.

9.4 Suggested improvement to SGN

HSE booklets HSG 51 and HSG 71 clearly state the correct and safe storage of such materials and their compatibility. Despite this material was not stored properly. A regular audit by a third party within the area of storage would highlight potential problems and help ensure unauthorised wastes are not on such sites.

Appendix A1

Submission Form for Serious Incidents at Hazardous Waste Treatment Facilities

Incident #	
Site name	**Date of incident**
Description of incident	
Description of causes ***The Process*** ***Background Information*** ***Other relevant information*** ***Action taken by operator since incident***	
BAT standards appropriate to the causes of the incident	
Suggested improvement to SGN	

References

HSE GUIDANCE References

- HSG51, Storage of flammable liquids in containers, ISBN 0-7176-1471-9
- HSG71, Chemical Warehousing – the storage of packaged dangerous substances ISBN 07176-1484-0
- HSG176, Storage of Flammable liquids in tanks, ISBN 0-7176-1470-0
- HSG143, Designing and Operating safe chemical reaction processes ISBN 0-7176-1051-9

Sector Guidance Note IPPC S5.06 - Guidance for the Recovery and Disposal of Hazardous and Non Hazardous Waste

PPC Permitting Plan for the Waste Disposal and Recovery Sector

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